STATION PAPER No. 7 AUGUST 1947

THE ASPEN - GRAY BIRCH FORESTS OF THE ANTHRACITE REGION

by C.F. Burnham
M.J. Ferree
F. E. Cunningham

U.S. Department of Agriculture
Forest Service

Northeastern Forest Experiment Station
Bankers Securities Building
Philadelphia 7, Pa.
V.L. Harper, Director

NORTHEASTERN FOREST EXPERIMENT STATION
OFFICE LIBRARY

FOREWORD

This paper is a progress report of forest research in the Anthracite Region by personnel of the Station's branch at Kingston, Pa. It is the fourth in a series of seven reports dealing with the principal forest types in the Anthracite Region. The reports completed are:

1. The Northern Hardwood Forests of the Anthracite Region. Station Paper No. 1, issued in March 1947.

2. The Red Oak - White Oak Forests of the Anthracite Region. Station Paper No. 2, issued in May 1947.

3. The Scrub Oak Forests of the Anthracite Region. Station Paper No. 4, issued in June 1947.

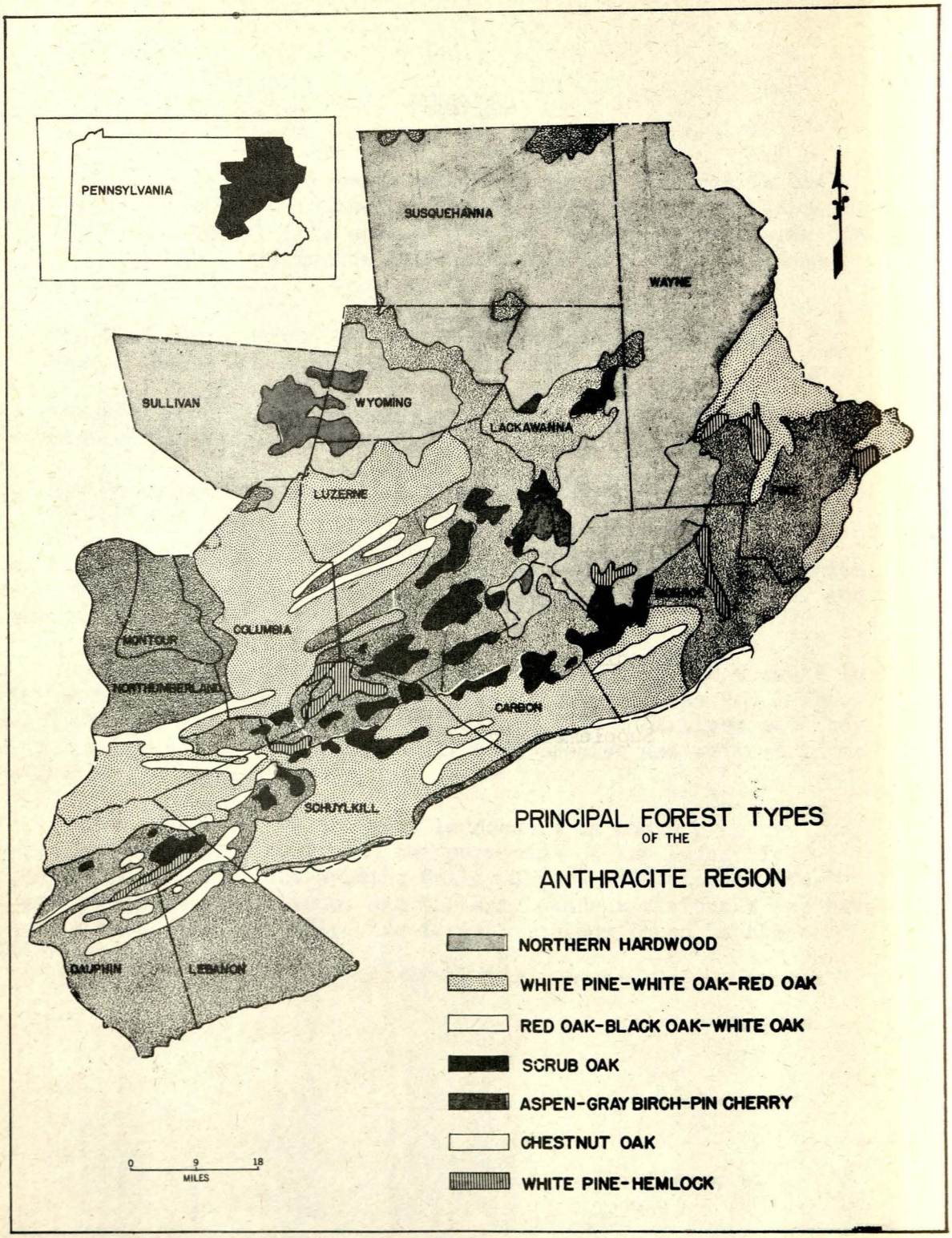
The other reports, all of which will be issued this year, deal with the white pine - hemlock forests, the white pine - oak forests, and the chestnut oak forests.

This report presents data on the condition of the forests in the aspen - gray birch forest type, and recommendations for improving such forests. The recommendations are only tentative; but they should serve as a useful guide until more precise and refined information is available.

The authors thank the many landowners on whose property the sample plots were established; the personnel of the Industrial Forestry Division of the Wyoming Valley Chamber of Commerce, for their advice and assistance; and the many other individuals who have shown a desire to help solve the forest problems found in the Anthracite Region.

CONTENTS

	Page
Introduction	1
Present condition	3
Measures needed to improve productivity. .	7
Literature cited	10
Appendix	
Definitions of terms .	11
Supplementary tables .	13


PENNSYLVANIA
SUSQUEHANNA
WAYNE
SULLIVAN
WYOMING
LACKAWANNA
LUZERNE
COLUMBIA
MONTOUR
NORTHUMBERLAND
CARBON
SCHUYLKILL
DAUPHIN
LEBANON
0 9 18
MILES
PRINCIPAL FOREST TYPES
OF THE
ANTHRACITE REGION
NORTHERN HARDWOOD
WHITE PINE-WHITE OAK-RED OAK
RED OAK-BLACK OAK-WHITE OAK
SCRUB OAK
ASPEN-GRAY BIRCH-PIN CHERRY
CHESTNUT OAK
WHITE PINE-HEMLOCK

THE ASPEN -- GRAY BIRCH FORESTS OF THE ANTHRACITE REGION

Their Present Condition and Possible Treatment

by C. F. Burnham
M. J. Ferree
F. E. Cunningham

INTRODUCTION

The aspen - gray birch forest type occupies about 98,000 acres in the Anthracite Region of Pennsylvania (see map). It is confined to two relatively small areas. One is in Sullivan and Wyoming Counties; the other in Luzerne and Lackawanna Counties.

This type of forest is composed of trembling aspen, gray birch, pin cherry, and a few remnants of red maple, black cherry, hickory, and beech. It generally is found where northern hardwood forests have been burned over after logging.

In their present condition these forests make practically no contribution to the supply of lumber and mine props so badly needed in the area. No portion of the acreage in this type meets the minimum qualifications of the saw-timber class1/ -- 2,000 or more board feet per acre (table 1). The few trees of sawlog size are decadent or are of inferior species.

These forests grow on areas that once were covered with valuable species. Repeated burning after heavy logging operations not only lowered the productivity of the sites, but also destroyed the seed sources of the desirable species. Aspen, on the other hand, has a tremendous capacity to regenerate itself by root suckers after fires; it reappears at once (1) (2) (3).2/ Gray birch also regenerates and makes exceptional growth after fires (5).

Moreover, Bess, Spurr, and Littlefield 3/ maintain that forests predominantly of aspen, gray birch, or oaks on dry sites are susceptible to infestation by the gypsy moth. This is not because aspen and gray birch are a favorite food source, but because "their presence is associated with fire, grazing, overcutting, or other forms of abuse that

---

1/ See appendix for definitions.
2/ Numbers in parentheses refer to Literature Cited, p. 10.
3/ Bess, Henry A., Spurr, Stephen H., and Littlefield, E. W. Forest site conditions and the gypsy moth. 1945. (Unpublished manuscript, Harvard Forest.)

Table 1.--Acreage and volume distribution in the aspen - gray birch type, by stand-size classes 1/

Item	Saw timber	Pole timber	Unmerchantable 2/ (Seedling and sapling)	All stands
Acres	--	6,600	91,500	98,100
Percent	--	6.7	93.3	100
Sawlog material:				
M bd. ft.....	--	2,100	2,300	4,400
Percent.....	--	47.7	52.3	100
Bd. ft. per acre..	--	318	25	45
Other material:				
Tons.....	--	67,100	635,700	702,800
Percent.....	--	9.5	90.5	100
Tons per acre.....	--	10	7	7
All material:				
M cu. ft.....	--	3,000	25,620	28,620
Percent.....	--	10.5	89.5	100
Cu. ft. per acre..	--	454	280	292

1/ Ineson, F. A., Ferree, M. J., and Robinson, D. F. The Anthracite Forest Region--a problem area. Northeast. Forest Expt. Sta. 1946. (In process of publication by U. S. Dept. Agr.) Data are for the entire 15-county area; percentages and volume-per-acre figures should not be confused with the plot figures that follow. In the report referred to the type is called aspen - gray birch - pin cherry.

2/ "Unmerchantable" as used in this table includes pole-timber tracts less than 10 acres in size. The term "seedling and sapling" used elsewhere in this report does not include these tracts.

create conditions favorable to survival of the gypsy moth larvae." A large area of the gypsy moth infestation in Luzerne and Lackawanna Counties has been in this forest type.

The ability of the more desirable species to filter gradually into these areas and eventually to replace the aspen and gray birch is doubtful, especially on the poorer sites. Some artificial means of speeding up the process may be necessary. Studies in the Lake States have led to the general conclusion that planting may be practical on some sites. Future research in the Anthracite Region should include similar studies. Ninety-eight thousand acres is too large an area to be left unproductive.

PRESENT CONDITION

Temporary sample plots were measured in order to determine the age, growth rate, character of stand composition, and manner of regeneration. These plots were distributed equally in seedling-and-sapling stands and on site I and site II. (The aspen - gray birch type has no saw-timber class and has little acreage on site III.)

Analysis of these measurements disclosed that the stocking of merchantable-sized trees is poor (table 2). Northern hardwood stands on similar sites have 20 to 50 percent more trees in the 4-inch diameter class and larger.4/ The seedling-and-sapling class has somewhat better stocking but includes few species of commercial value.

Because of better growth rate and a slightly better composition, site I stands have a larger cubic-foot volume than site II stands. They are about the same age. Site II stands are mostly aspen, red maple, gray birch, fire cherry, and black cherry. On site I there is little or no gray birch or fire cherry; and sugar maple, red oak, hickory, white pine, and white ash make the site I forest more valuable.

Although the better species are present on site I, mortality is high because the aspen dies as it is crowded out of the stand. It cannot endure the competition from more tolerant species. The heaviest mortality is in the 1- to 3-inch diameters on both sites. Cull volume is also high on both sites; aspen accounts for most of it.

Poorly formed stems constitute a third of the volume of pole-timber stands and over two-thirds of the volume of seedling-and-sapling stands (tables 4-11). The large percentage of high-vigor trees is due to poor stocking and consequent crown expansion.

The low volume in species of commercial value results in poor growth even in young stands. The high mortality and excessive cull in the principal species (aspen) offsets the growth. On site I aspen is often of good quality; and white ash, black cherry, red maple, red oak, and white pine gradually take over as the aspen dies. This appears to occur when the stand is between 40 and 60 years old.

Site II stands, however, comprise the bulk of the aspen - gray birch acreage. Here about 80 percent of the total volume is aspen, gray birch, and fire cherry (tables 7 and 11). Few seed trees of commercial species, poor seedbed conditions, and competition from sprouts prevent conversion to productive forest.

4/ Burnham, C. F., Ferree, M. J., and Cunningham, F. E. The northern hardwood forests of the Anthracite Region. Northeast. Forest Expt. Sta. Paper 1. 1947.

Table 2.--Summary of conditions in aspen - gray birch stands

Average condition	Pole timber		Seedling and sapling	
	Site I	Site II	Site I	Site II
Volume per acre .... Cubic feet..	1,291	669	143	119
Tons..	31.5	16.3	3.5	2.9
Board feet..	494	105	--	--
Average age .....Years..	42	42	22	29
Trees per acre Pole size (3.6" d.b.h.) and larger .....Number..	288	335	126	152
Seedling and sapling (0.6-3.5" d.b.h.) ... Number..	1,004	867	1/ 2,948	1/ 2,646
Reproduction ..... Degree.. (under 4.5' high)	Poor	Poor	Poor	Poor
Quality ..... Percent of total cu.-ft. volume in poorly formed trees..	33.8	39.0	72.5	66.4
Origin ..... Percent of total cu.-ft. volume in sprout-origin trees..	7.8	18.2	4.4	9.6
Vigor ..... Percent in vigor class 1..	18.5	18.4	29.3	41.7
vigor class 2..	32.9	41.2	34.3	36.5
vigor class 3..	32.6	31.6	31.4	18.3
vigor class 4..	16.0	8.8	5.0	3.5
Cull ..... Percent of total cu.-ft. volume..	6.4	7.8	9.6	6.1
of total bd.-ft. volume..	11.4	50.0	--	--
Annual mortality ... Cubic feet per acre..	17.0	3.7	2.3	--
Percent of total growth..	25.0	8.1	20.3	--
Annual growth per acre ....Cubic feet..	51	38	17	15
Tons..	1.24	0.93	0.41	0.37
Ingrowth .....Percent of annual cu.-ft. increase..	14.4	27.2	73.4	57.0
of annual bd.-ft. increase..	88.2	--	--	--

1/ Includes trees down to 0.1 inches d.b.h.

Table 3.--Growth data for natural aspen - gray birch stands

MORTALITY NOT DEDUCTED [1/]

Growing stock per acre	Annual growth per acre		Growing stock per acre	Annual growth per acre	
	Site I	Site II		Site I	Site II
Cubic feet	Cubic feet	Cubic feet	Tons	Tons	Tons
200	25	24	4.9	0.6	0.6
400	41	35	9.8	1.0	.8
600	55	43	14.6	1.3	1.0
800	66	49	19.5	1.6	1.2
1,000	73	52	24.4	1.8	1.3
1,200	77	--	29.3	1.9	--
1,400	80	--	34.1	2.0	--

MORTALITY DEDUCTED [1/]

200	20	20	4.9	0.5	0.5
400	29	29	9.8	.7	.7
600	36	36	14.6	.9	.9
800	41	41	19.5	1.0	1.0
1,000	46	46	24.4	1.1	1.1
1,200	50	50	29.3	1.2	1.2
1,400	53	53	34.1	1.3	1.3

1/ Since mortality is much greater on site I than on site II, the growth rates are about the same after mortality is deducted.

Converting factor: 41 cubic feet = 1 ton.

Figure 1.--Pole-timber stand, site I.

Figure 2.--Pole-timber stand, Site II

MEASURES NEEDED TO IMPROVE PRODUCTIVITY

The natural conversion of site I stands to productive forests can be speeded by releasing the better species, removing dominant aspen, and thinning to improve growth and composition. However, the specific recommendations for such treatments, the costs, and the improved growth rates that will result must await further research.

The big problem, both in acreage occupied and in difficulties, is the almost worthless site II stands. Planting will undoubtedly be required to convert them. Introduction of better species on this site through direct seeding is likely to prove both uncertain and costly. Studies in a similar forest type in the Lake States determined that mineral seedbeds must be prepared, seed or seedlings must be protected from rodents, and frequent liberation must be made in order to successfully establish a new stand by direct seeding (4).

In gray birch stands or where the aspen overstory is thin, it may prove feasible to underplant with white or red pine transplants, red pine to be planted in openings. Toumey (6) found that the light foliage of birch trees interfered very little with the growth of underplanted white pines. About 500 trees per acre should be planted, taking full advantage of openings in the crowns of the overstory. When the growth slows down because of excessive shade, the overtopping trees should be removed--by girdling if they have no commercial value.

Where the aspen is dense it will have to be thinned out before underplanting.[5/] Shirley's methods (4) for restoring conifers to aspen lands in the Lake States are worthy of trial in aspen areas of the Anthracite Region. These procedures, with some modifications, are as follows:

1. Select areas, preferably of good soil, on which aspen is small or sparse, and not in the vicinity of swamps used by deer as winter yarding grounds.

2. Choose tree species to suit soil quality. (White pine and red pine are suitable for the Anthracite Region.)

3. Use large, high-quality transplant stock, preferably 2-2.

4. Thin the overstory to admit 50 percent or stronger light, but leave enough to shade each planted conifer during some portion of the day.

5. Open up the undergrowth to prevent excessive shading and root competition.

5/ Lake States Forest Experiment Station. Planting under aspen can be made successful. Lake States Forest Expt. Sta. Tech. Note 80. 1934.

Figure 3.--Seedling-and-sapling stand, site I.

Figure 4.--Seedling-and-sapling stand, site II.

6. Prepare the planting area by plowing furrows or by carefully scalping 20-inch-square spots so that the trees will be free from immediate competition of other vegetation.

7. Plant carefully by the deep-hole method, to insure spreading of roots.

8. Maintain rapid growth by early and frequent weedings until the conifers have overtopped the undergrowth.

9. Protect planted areas from deer by fencing, and from rabbits by fencing or snaring if necessary. White pine plantings will need the usual protection against the blister rust disease.

10. Remove the overstory when the conifers have reached heights of 4 to 6 feet, exposing relatively narrow strips of plantation at one time and leaving enough overstory material to prevent drying winds from gaining access to the soil.

The above method of restoring conifers to aspen lands was estimated by Shirley (4) to cost $25-$30 per acre in the Lake States. This was in 1939 or 1940. He concludes it is unlikely that over the first rotation of conifers the returns would offset the costs, but the rate of interest might be low.

Further studies of this problem in the Anthracite Region are needed to develop more applicable methods of restoring these forests to greater production at reasonable costs.

L I T E R A T U R E C I T E D

(1) Baker, Frederick S.
1918. Aspen as a temporary forest type. Jour. Forestry 16: 294-303, illus.

(2) Kittredge, J. Jr., and Gevorkiantz, S. R.
1929. Forest possibilities of aspen lands in the Lake States. Minn. Agr. Expt. Sta. Tech. Bul. 60. 84 pp., illus.

(3) Shirley, Hardy L.
1931. Does light burning stimulate aspen suckers? Jour. Forestry 29: 524-525.

(4) ----------
1941. Restoring conifers to aspen lands in the Lake States. U. S. Dept. Agr. Tech. Bul. 763. 35 pp., illus.

(5) Skutch, Alexander F.
1929. Early stages of plant succession following forest fires. Ecology 10: 177-190, illus.

(6) Toumey, J. W.
1919. The relation of gray birch to the regeneration of white pine. Jour. Forestry 17: 15-20.

APPENDIX

DEFINITIONS OF TERMS

The use of terms in this paper is in accord with the definitions given below.

Forest Sites

Site I.--This site is usually found in protected coves or along streams or bottom-lands that maintain moist, well-drained conditions throughout the year. On northern exposures, it ordinarily extends higher up the slope than on southern exposures because of more soil moisture. Club moss, hydrangea, maidenhair fern, trillium, sphagnum moss, and fern-leaf moss are fairly good indicators.

Site II.--Site II areas are characterized by soils intermediate in moisture, depth, drainage, and fertility. They dry out for only short periods during the year. Usually they are slope types located between the ridges and the coves or bottom-lands, but usually reaching nearly to the ridge tops. Poorly drained bottom-lands may be of site II quality. Trailing arbutus, ground pine, aster, goldenrod, bracken fern, and sheep laurel usually indicate site II.

Site III.--This site is characterized by shallow, rather dry, stony, or compact soils characteristic of ridges. On southern exposures it may extend down a slope for a considerable distance, because of unfavorable soil moisture conditions. Dense mountain laurel or a preponderance of lichens often indicate site III conditions.

Forest Stand-size Classes

Saw-timber stands.--Stands bearing a minimum volume of 2,000 board feet per acre. Saw-timber volume is measured in conifers in the 9-inch d.b.h. class and over, and in hardwoods in the 11-inch d.b.h. class and over.

Pole-timber stands.--Stands bearing a minimum volume of 5 standard cords per acre in trees in the 4-inch d.b.h. class and over, and less than 2,000 board feet of saw-timber.

Seedling and sapling.--Areas of young growth having less than 5 standard cords of wood per acre in trees in the 4-inch d.b.h. class and over.

Tree Vigor Classifications

Vigor class 1.--Trees in this class have large dense crowns. They are usually dominant or co-dominant with at least one-half of their crowns exposed. They are free from diseases or mechanical breakage tending to reduce the crown surface. (Small mechanical injuries on tree trunks do not affect the vigor classification.) They are free from old-age stagnation as evidenced by dead limbs in the crown, and have a general healthy and thrifty appearance.

Vigor class 2.--Trees in this class have fair-sized crowns of moderate density or large crowns of light density. They are usually co-dominant with less than one-half the crown exposed, but with more than the tip in the open in well-stocked uncut stands. They are free from diseases or mechanical breakage tending to reduce the crown surface, and are free from old-age stagnation. They may be trees that are dropped from vigor class 1 because of injury, disease, or old age.

Vigor class 3.--Trees in this class have small, dense crowns with just the tips exposed and are free from diseases and mechanical injuries tending to reduce crown surface. They have not reached old-age stagnation. They may be trees that are dropped from vigor classes 1 or 2 because of injury, disease, or old-age.

Vigor class 4.--Trees growing under obvious handicaps, such as severe suppression, injury, disease, or old age.

Table 4.--Site I, pole timber: Number of trees per acre, by species and diameter

D.b.h. (inches)	White pine	White oak	Red oak	Sugar maple	Red maple	Yellow birch	Gray birch	Aspen	White ash	Black cherry	Misc. 1/	Total	Percent
1	--	--	8	--	146	--	59	28	8	8	391	648	64.5
2	--	--	--	--	15	--	49	49	--	8	131	252	25.1
3	--	--	--	--	--	--	8	57	8	16	15	104	10.4
Total	--	--	8	--	161	--	116	134	16	32	537	1004	100.0
Percent	--	--	0.8	--	16.0	--	11.6	13.3	1.6	3.2	53.5	100.0	--
4	3.0	--	1.6	0.7	2.2	2.0	2.5	41.1	4.0	5.3	5.0	67.4	23.3
5	4.6	0.7	--	1.3	12.4	--	1.9	30.2	--	4.4	1.5	57.0	19.8
6	.8	--	1.6	--	4.8	--	.7	37.1	1.5	1.6	2.0	50.1	17.4
7	2.1	.7	--	--	1.5	--	--	25.2	.8	--	.7	31.0	10.8
8	--	--	--	--	.7	--	--	31.5	1.6	--	--	33.8	11.7
9	--	--	1.6	--	2.0	.7	--	21.6	--	.8	.8	27.5	9.5
10	--	--	1.6	--	.7	--	--	11.7	--	--	--	14.0	4.9
11	--	--	--	--	.7	--	--	4.9	--	--	--	5.6	1.9
12	--	--	--	--	--	--	--	1.3	--	--	--	1.3	.5
13	--	--	--	--	--	--	--	.5	--	--	--	.5	.2
Total	10.5	1.4	6.4	2.0	25.0	2.7	5.1	205.1	7.9	12.1	10.0	288.2	100.0
Percent	3.6	0.5	2.2	0.7	8.7	0.9	1.8	71.2	2.7	4.2	3.5	100.0	--

1/ Includes noncommercial species--serviceberry, hornbeam, hop-hornbeam, witch hazel, sassafras, fire cherry--totaling 529 stems under 4 inches d.b.h. and 6.5 stems over 4 inches d.b.h.; and commercial species--hemlock, basswood, red spruce, black birch, yellow poplar, and hickory--totaling 8 stems under 4 inches d.b.h. and 3.5 stems over 4 inches d.b.h.

Table 5.--Site I, pole timber: Volume per acre by species and diameter, and by tree form

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
White pine	10.2	11.2	21.4	1.7	--	--	--	--
Hemlock	--	.6	.6	--	--	--	--	--
Red spruce	--	.2	.2	--	--	--	--	--
White oak	4.4	--	4.4	.3	--	--	--	--
Red oak	.8	38.4	39.2	3.1	--	--	--	--
Sugar maple	.3	1.8	2.1	.1	--	--	--	--
Red maple	43.0	41.2	84.2	6.5	--	42	42	8.5
Yellow birch	7.3	.3	7.6	.6	--	--	--	--
Black birch	.3	--	.3	--	--	--	--	--
Gray birch	5.0	1.0	6.0	.5	--	--	--	--
Aspen	334.3	728.1	1,062.4	82.5	131	321	452	91.5
White ash	3.2	19.3	22.5	1.7	--	--	--	--
Basswood	8.8	--	8.8	.7	--	--	--	--
Yellow poplar	2.3	--	2.3	.2	--	--	--	--
Black cherry	7.1	12.6	19.7	1.5	--	--	--	--
Sassafras	8.3	--	8.3	.6	--	--	--	--
Misc. 1/	.6	--	.6	--	--	--	--	--
Total	435.9	854.7	1,290.6	100.0	131	363	494	100.0
D.b.h.: (Inches)								
4	27.0	6.1	33.1	2.6	--	--	--	--
5	54.2	18.4	72.6	5.6	--	--	--	--
6	99.3	53.7	153.0	11.9	--	--	--	--
7	55.6	107.0	162.6	12.6	--	--	--	--
8	49.4	213.2	262.6	20.3	--	--	--	--
9	110.0	178.2	288.2	22.4	--	--	--	--
10	6.8	181.2	188.0	14.5	--	--	--	--
11	21.8	70.9	92.7	7.2	78	258	336	68.1
12	--	26.0	26.0	2.0	--	105	105	21.2
13	11.8	--	11.8	.9	53	--	53	10.7
Total	435.9	854.7	1,290.6	100.0	131	363	494	100.0
Percent	33.8	66.2	100.0	--	26.5	73.5	100.0	--

1/ Shadbush, blue beech, witch hazel, ironwood.

Table 6.--Site II, pole timber: Number of trees per acre, by species and diameter

D.b.h. (inches)	Red oak	Red maple	Yellow birch	Gray birch	Aspen	Beech	Black cherry	Fire cherry	Misc. 1/	Total	Percent
1	--	180	10	99	64	8	--	32	21	414	47.8
2	--	57	20	33	68	--	--	48	50	276	31.8
3	--	58	--	15	88	8	--	8	--	177	20.4
Total	--	295	30	147	220	16	--	88	71	867	100.0
Percent	--	34.0	3.5	17.0	25.4	1.8	--	10.1	8.2	100.0	--
4	4.0	27.6	1.6	13.5	80.4	1.0	2.4	0.8	--	131.3	39.1
5	1.0	15.0	--	13.2	55.4	2.0	1.6	.8	--	89.0	26.6
6	--	8.4	--	5.0	39.0	--	2.4	--	--	54.8	16.4
7	--	7.4	--	.7	23.2	--	2.4	--	--	33.7	10.1
8	--	.7	--	1.0	15.4	--	--	--	--	17.1	5.1
9	--	--	--	--	8.2	--	--	--	--	8.2	2.4
13	--	--	--	--	1.0	--	--	--	--	1.0	.3
Total	5.0	59.1	1.6	33.4	222.6	3.0	8.8	1.6	--	335.1	100.0
Percent	1.5	17.6	0.5	10.0	66.4	0.9	2.6	0.5	--	100.0	--

1/ Noncommercial species: serviceberry, witch hazel.

Table 7.--Site II, pole timber: Volume per acre, by species and diameter, and by tree form

Item	Poor form	Good form	Total		Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent	Board feet	Board feet	Board feet	Percent
Species:								
Red oak	0.9	1.6	2.5	0.3	--	--	--	--
Red maple	55.6	31.4	87.0	13.0	--	--	--	--
Yellow birch	.6	--	.6	.1	--	--	--	--
Gray birch	34.6	6.2	40.8	6.1	--	--	--	--
Aspen	153.5	365.0	518.5	77.6	105	--	105	100.0
Beech	1.9	--	1.9	.3	--	--	--	--
Black cherry	13.0	4.2	17.2	2.5	--	--	--	--
Fire cherry	1.0	--	1.0	.1	--	--	--	--
Total	261.1	408.4	669.5	100.0	105	--	105	100.0
D.b.h. (Inches)								
4	29.3	19.0	48.3	7.2	--	--	--	--
5	49.5	41.5	91.0	13.6	--	--	--	--
6	66.9	74.9	141.8	21.2	--	--	--	--
7	38.2	120.5	158.7	23.7	--	--	--	--
8	33.0	90.9	123.9	18.5	--	--	--	--
9	21.2	61.6	82.8	12.4	--	--	--	--
13	23.0	--	23.0	3.4	105	--	105	100.0
Total	261.1	408.4	669.5	100.0	105	--	105	100.0
Percent	39.0	61.0	100.0	--	100.0	--	100.0	--

Table 8.--Site I, seedling and sapling: Number of trees per acre, by species and diameter

D.b.h. (inches)	White oak	Sugar maple	Red maple	Gray birch	Aspen	Beech	White ash	Black cherry	Hick-ory	Fire cherry	Misc.[1/]	Total	Per-cent
0.25	4	--	6	350	102	4	10	8	--	--	172	656	22.3
1	4	2	94	926	258	18	2	6	4	20	250	1584	53.7
2	--	8	58	176	174	--	2	--	--	24	6	448	15.2
3	--	--	42	42	168	--	--	--	--	8	--	260	8.8
Total	8	10	200	1494	702	22	14	14	4	52	428	2948	100.0
Percent	0.3	0.3	6.8	50.7	23.8	0.7	0.5	0.5	0.1	1.8	14.5	100.0	--
4	--	2	4	4	60	--	--	--	--	2	2	74	58.7
5	--	4	--	--	36	--	--	--	2	--	--	42	33.3
6	--	--	--	--	4	--	--	--	--	--	--	4	3.2
7	--	--	--	--	4	--	--	--	--	--	--	4	3.2
9	--	--	--	--	2	--	--	--	--	--	--	2	1.6
Total	--	6	4	4	106	--	--	--	2	2	2	126	100.0
Percent	--	4.8	3.2	3.2	84.0	--	--	--	1.6	1.6	1.6	100.0	--

1/ Noncommercial species: serviceberry, hawthorn, alder, willow, hornbeam.

Table 9.--Site I, seedling and sapling: Volume per acre, by species and diameter, and by tree form

Item	Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent
Species:				
Sugar maple	2.8	3.8	6.6	4.5
Red maple	2.0	--	2.0	1.4
Gray birch	1.0	1.0	2.0	1.4
Aspen	96.2	32.0	128.2	89.5
Hickory	--	2.6	2.6	1.8
Fire cherry	1.0	--	1.0	.7
Misc.1/	1.0	--	1.0	.7
Total	104.0	39.4	143.4	100.0
D.b.h.: (Inches)				
4	26.0	11.0	37.0	25.8
5	29.2	22.2	51.4	35.9
6	6.2	6.2	12.4	8.6
7	21.2	--	21.2	14.8
9	21.4	--	21.4	14.9
Total	104.0	39.4	143.4	100.0
Percent	72.5	27.5	100.0	--

1/ Noncommercial species: shadbush, crataegus, alder, willow, and blue beech.

Table 10.--Site II, seedling and sapling: Number of trees per acre, by species and diameter

D.b.h. (inches)	White pine	Hem-lock	Red maple	Gray birch	Aspen	Black cherry	Fire cherry	Misc.[1/]	Total	Per-cent
0.25	--	--	238	166	84	30	28	246	792	29.9
1	--	2	364	198	212	36	144	62	1018	38.5
2	2	--	118	204	180	4	42	6	556	21.0
3	--	2	42	104	118	--	14	--	280	10.6
Total	2	4	762	672	594	70	228	314	2646	100.0
Percent	0.1	0.2	28.8	25.4	22.4	2.6	8.6	11.9	100.0	--
4	2	--	12	24	52	4	10	--	104	68.4
5	--	--	--	2	30	--	2	--	34	22.4
6	--	--	--	--	10	--	--	--	10	6.6
7	--	--	--	--	4	--	--	--	4	2.6
Total	2	--	12	26	96	4	12	--	152	100.0
Percent	1.3	--	7.9	17.1	63.2	2.6	7.9	--	100.0	--

1/ Noncommercial species: willow, alder, holly, dogwood, hawthorn, serviceberry.

Table 11.--Site II, seedling and sapling: Volume per acre, by species and diameter, and by tree form

Item	Poor form	Good form	Total	
	Cubic feet	Cubic feet	Cubic feet	Percent
Species:				
White pine	.8	--	.8	.7
Red maple	1.6	3.2	4.8	4.0
Gray birch	11.0	.8	11.8	10.0
Aspen	59.6	34.2	93.8	79.1
Black cherry	--	1.6	1.6	1.3
Fire cherry	5.8	--	5.8	4.9
Total	78.8	39.8	118.6	100.0
D.b.h.: (Inches)				
4	30.6	8.4	39.0	32.8
5	28.0	6.0	34.0	28.6
6	10.4	15.6	26.0	22.0
7	9.8	9.8	19.6	16.6
Total	78.8	39.8	118.6	100.0
Percent	66.4	33.6	100.0	--